BONNEVILLE POWER ADMINISTRATION

Habitat Evaluation Procedures (HEP) Report;

Forrest Conservation Area

Technical Report 2003 - 2004 January 2005 DOE/BP-00008167-3

This Document should be cited as follows:

Smith, Brent, "Habitat Evaluation Procedures (HEP) Report;; Forrest Conservation Area", 2003 -2004 Technical Report, Project No. 200104101, 47 electronic pages, (BPA Report DOE/BP-00008167-3)

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This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

Confederated Tribes of the Warm Springs Reservation of Oregon
Forrest Conservation Area
2003 Baseline Habitat Evaluation Procedure Report

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January 5, 2005

BPA Project Number 2001-041-00
BPA Contract Number 00008167

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Abstract
The Habitat Evaluation Procedure (HEP) study was performed to determine baseline habitat units on the 4,232-acre Forrest Conservation Area managed by the Confederated Tribes of Warm Springs Reservation of Oregon (Tribe) in Grant County, Oregon. The habitat evaluation is required as part of the Memorandum of Agreement between the Confederated Tribes of the Warm Springs and Bonneville Power Administration.

Representatives from the Washington Department of Fish and Wildlife and the Tribes conducted the field surveys for the HEP. The survey collected data for habitat variables contained in habitat suitability index (HIS) models for wildlife species; the key species were black-capped chickadee (*Poecile atricapilla*), mallard (*Anas platyrhynchos*), mink (*Mustela vison*), western meadowlark (*Sturnella neglecta*), mule deer (*Odocoileus hemionus*), California Quail (C*allipepla californica*), and yellow warbler (*Dendroica petechia*). Cover types surveyed were grassland, meadow grassland, conifer forest, riparian tree shrub, shrub steppe, juniper forest, and juniper steppe. Other cover types mapped, but not used in the models were open water, roads, gravel pits, corrals, and residential.

The project generated 4,083.89 habitat units for mitigation crediting purposes. General results for species are listed below. The ratings (poor, marginal, etc.) are described in the introduction section.

Black-capped chickadee - habitat was fair, with areas lacking number of snags.
Mallard - habitat was fair with areas lacking in herbaceous height.
Mink - habitat was poor due to lack of shrubs.
Western meadowlark - habitat was marginal due to a combination of distance to perch sites and height of herbaceous canopy.
Mule deer – habitat was poor due to lack of preferred shrub heights.
Yellow Warbler - habitat was fair due to low deciduous shrub height and lack of hydrophytic shrubs.
California Quail – habitat was fair due to limiting size and height of shrub.

Introduction

The Tribes acquired the Forrest Conservation Area in July 2002. Bonneville Power Administration (BPA) funded the acquisition and ongoing management of the property as a fish and wildlife mitigation and restoration project. Partial mitigation credits for wildlife habitat lost from the construction of the John Day Dam will be obtained by BPA from the Forrest Conservation Area acquisition.

The HEP was performed at the Forrest Conservation Area to determine baseline habitat conditions. HEP was developed by the U.S. Fish and Wildlife Service (USFWS), and is used to quantify impacts of development, protection, and restoration projects on terrestrial and aquatic habitats by assessing changes, both negative and positive, in habitat quality and quantity (USFWS 1980a). The process is a habitat-based approach to assess impacts that document change through use of a habitat suitability index (HIS). The HIS value is derived from an evaluation of the ability of key habitat components to provide life requisites of selected wildlife and fish species.

The HIS value is an index to habitat carrying capacity for a specific species based on a performance measure described in species models. The index ranges from 0.0 to 1.0 for the quality/carrying capacity of habitat with 1 being optimum and 0 poor. HIS models for a single species or guild are used to identify changes in both habitat quality and quantity for specific habitat/cover types. Habitat units are used to estimate habit losses or gains. Habitat units are calculated by multiplying HIS values by the number of acres for each cover type.

Table 1. A comparison of mathematical HSI scores and equivalent verbal expressions.

Habitat Suitability Index	Verbal Equivalent
0.0 < 0.2	Poor
0.2 < 0.4	Marginal
0.4 < 0.6	Fair
0.6 < 0.9	Good
0.9 < 1.0	Optimum

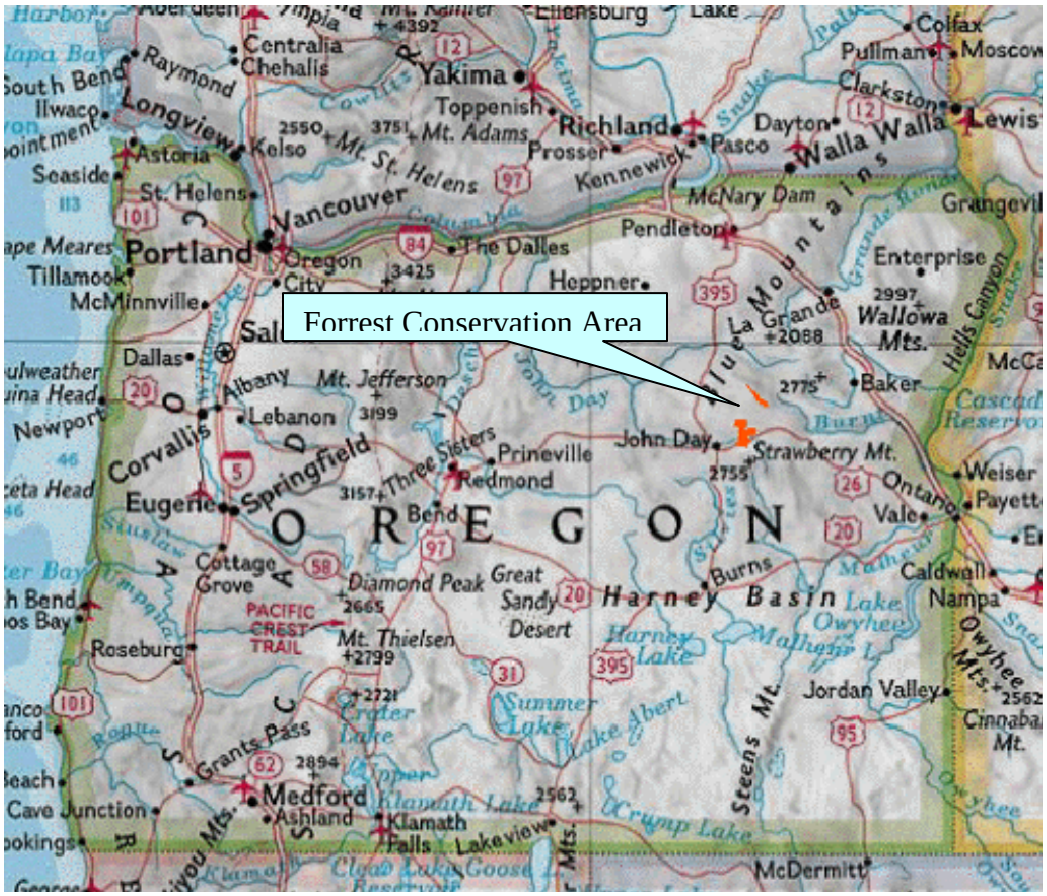
Study Area

The Forrest Conservation Area was selected as a mitigation site by the tribes for BPA primarily for its fisheries spawning and rearing habitat values for spring Chinook salmon and summer steelhead. The Conservation Area consists of two geographically separated parcels located in the upper sub-basins of the mainstem and middle fork of the John Day Basin. The mainstem parcel, 3,445 acres (545 floodplain, riparian, wetland and 2,900 upland), is located ½ mile to the east of Prairie City, Oregon along the mainstem of the John Day River. The Middle Fork parcel, 786 acres (300 floodplain, riparian, wetland, and 87 timbered upland), is located 2 miles west of the town Bates along the Middle Fork

of the John Day river. The Conservation Area contains approximately 4 miles of the Middle Fork John Day River, 1.7 miles of the mainstem John Day River and 5 miles of associated tributaries.

The mainstem parcel is completely surrounded by private property while the middle fork parcel is almost entirely surrounded by the Malheur National Forest with only 3/16 of a mile of private property bordering the east boundary.

Figure 1. Location of Forrest Conservation Area in Grant County, Eastern Oregon.



Methods

Survey Team:

On May 24th through the 26th of 2003, a HEP team evaluated the baseline habitat conditions on the Forrest Conservation Area. Paul Ashley Washington Department of Fish and Wildlife (WDFW) representative along with Regional HEP crewmembers of the Columbia Basin Fish and Wildlife Authority (CBFWA) and Brent Smith, Brian Cochran Steve Zehtner, and Sue Malaney employees of the Confederated Tribes of Warm Springs Reservation of Oregon conducted the field surveys.

Cover Types:

The property cover types were initially mapped using GIS and aerial photographs from 1987 in 2003. The maps produced in 2003 were further corrected in 2004 for the final habitat cover type maps. The cover types residential and road were not considered for evaluation. Habitat maps will be modified and updated as needed.

Cover types used for the HEP were to be as similar as possible to those reported lost in the Wildlife Impact assessment Bonneville project, Oregon and Washington (Rasmussen, Wright 1989). Cover types used are listed in table 2.

Table 2. Habitat Cover Types on Forest Conservation Area.

Habitat Cover Type	Acres
Mainstem property	
Riparian tree-shrub	69.7
Meadow grassland	440.7
Shrub steppe	676.4
Grassland	1,757.8
Juniper forest	301.9
Juniper steppe	194.2
Residential	3.6
Open water	7.3
Roads	24.01
Gravel pit	1.3
Total	**3,476.91**
Middle Fork property	
Riparian tree shrub	.7
Meadow grassland	340.3
Grassland	18.8
Conifer forest	413.9
Open water	12.8
Gravel pit	9.5
Corrals	2
Roads	9.8
Total	**807.8**

Model Selection:
Models were chose by Paul Ashley for the HEP. Mallard, western meadowlark, mink, yellow warbler, black-capped chickadee, California quail, and mule deer were the models used. Substitutions were allowed for in the Memorandum of Agreement between the Tribe and BPA and mule deer was the only substitution used. The original models chosen at the John Day pool were spotted sandpiper, lesser scaup, Canada goose, great blue heron, yellow warbler, black-capped chickadee, mink, western meadowlark, California quail, and Mallard. Of these, all species except lesser scaup can, at times, be found on the Conservation Area.

Transect Site Selection:
Twenty-nine randomly chosen transects were identified on the property and distributed over every cover type. Of these, there were four conifer, eight grassland, six riparian, three shrub steppe, six Juniper steppe, and one Juniper forest (See Maps Figure 2 Middle Fork and Figure 3 Mainstem).

Field Methods:
The field survey was conducted May 24th through the 26th of 2003. Transect starting points were marked with rebar, and GPS waypoints were noted on data sheets. Transect azimuths were randomly selected to stay within the cover type and property. In certain circumstances, the transect may have a change in direction to avoid obstructions (such as a body of water). These changes in azimuths were noted on the data sheets and marked with rebar on the ground. A digital photograph was taken from the initial starting point of each transect. Transect information was displayed on a board in each photograph.

Transect lengths varied between cover types and ranged from 200 to 1000 feet in length. Grassland cover types transects were linear and 300 to 600 feet in length. Conifer transects were linear and ranged from 600 to 1000 feet. Riparian transects were initially set along the river's edge for 300 feet. At the start and stop of the riparian transect additional paired transects were run perpendicular to the stream on each side covering meadow grassland. The perpendicular transects varied from 300 to 600 feet.

Figure 2. Middle Fork Parcel Habitat Cover Types Map

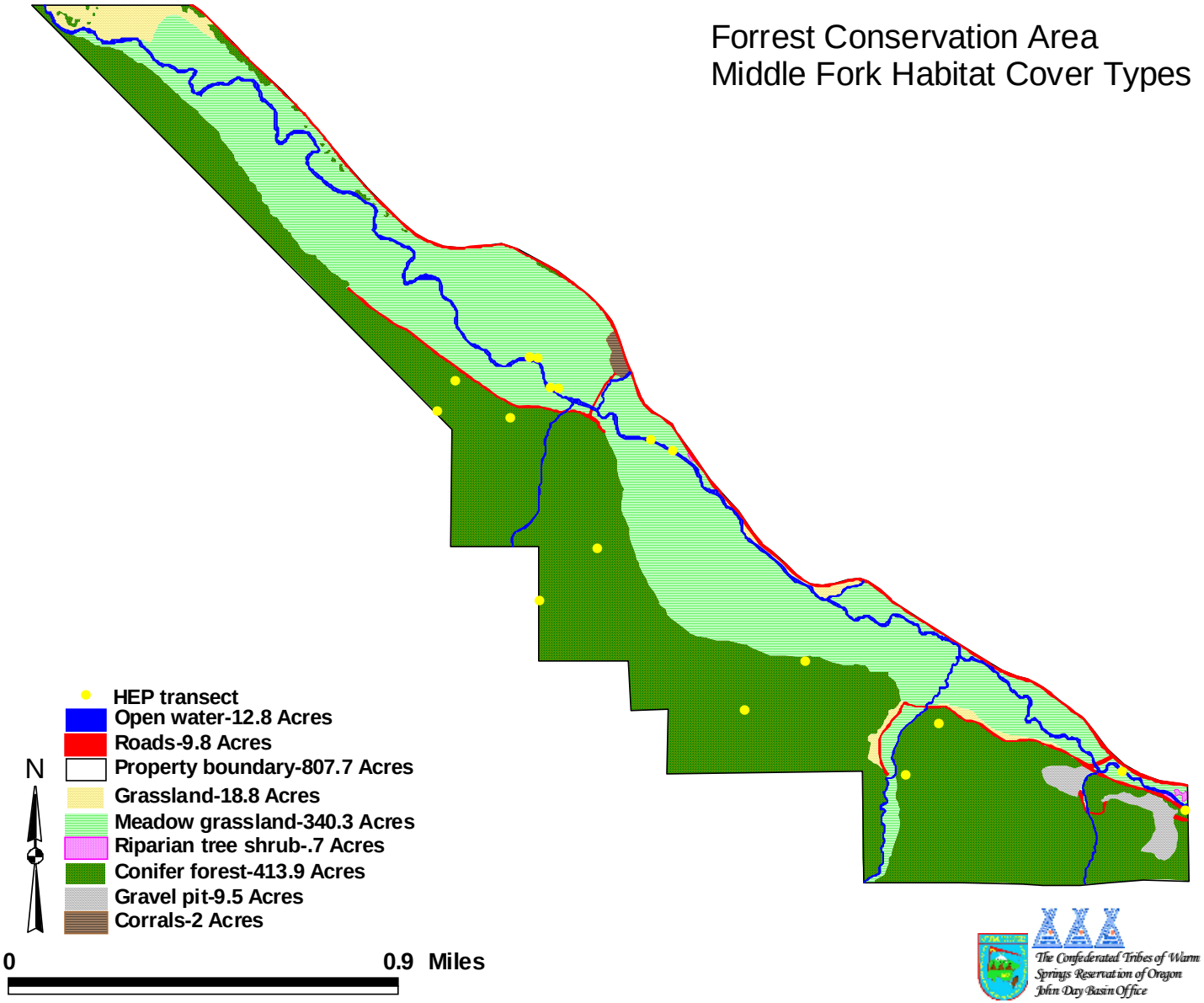
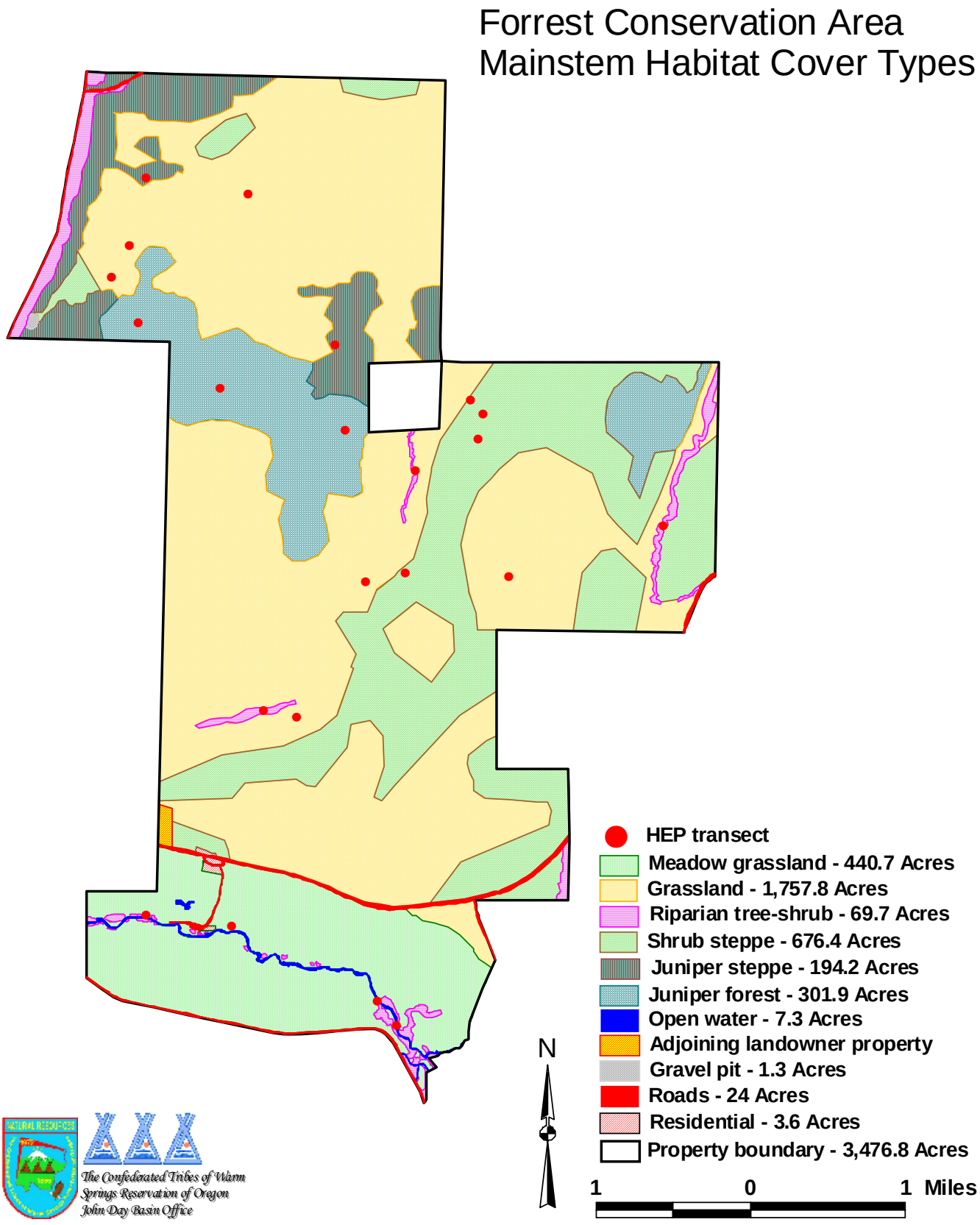


Figure 3. Mainstem parcel habitat cover type map



On each transect, data was collected as necessary for the HSI model(s). Table 3 presents a summary of the data collection protocols for the various models.

Table 3. HEP model variables and techniques.

Species	Technique	Variable
Black-capped Chickadee	Densiometer	V1: % Tree Canopy Cover
	Clinometer	V2: Average Height of overstory trees
	DBH Tape/Quadrat	V3: # of snags 4" to 10" dbh per acre
Mallard	Microplot	V1: % Herbaceous cover
	Graduated rod	V2: Mean height of herbaceous cover
	Tape measurement	V3: Distance to water
	Aerial map/estimation	V5: Size of water body
	Robel pole	V7: Visual Obstruction Reading
Mink	Aerial Photos/Maps	V1: % of Year Water Present
	Line Intercept	V5: % Canopy Cover <100 m of wetland edge
	Observation	V6: % Canopy Cover <3 ft. of shoreline
Western Meadowlark	Microplot	V1: % Canopy Cover Herbaceous Plants
	Microplot/estimation	V2: % Herb. C.C. Composed of Grass
	Graduated rod	V3: Ave. Ht. of Herb. Canopy
	Tape/range finder	V4: Distance to Perch Sites
	Line Intercept	V5: % Shrub Canopy Cover
Mule Deer	Line Intercept/ Graduated rod	V1: % cover of preferred Shrubs $\leq$ 1.5 meters in height.
	Direct count	V2: Number of preferred Shrub species
	Graduated rod	V3: Mean shrub height
	Line intercept	V4: % cover of all shrub $\leq$ 1.5 meters in height
	Grid plot frame	V5: % canopy of palatable Herbaceous species
	Aerial photo direct observation	V6: Presence of suitable agricultural crops within 1.6 km (1mile) of area
	Compass GIS maps/data	V7: Aspect
	Aerial photos, maps	V8: Road density
	Aerial photos, maps	V9: Topographic diversity
	Densitometer, aerial photos	V10: % evergreen canopy $\geq$ 1.5 meters in height
Yellow Warbler	Line Intercept	V1: % Deciduous Shrub Crown Cover
	Tape Measure	V2: Ave. Ht. of Deciduous Shrub Canopy
	Line Intercept	V3: % Deciduous Shrub Canopy Comprised of Hydrophytic Shrubs
California Quail	Microplot	V1: % Canopy Cover of grasses and herbs
California	Tape Measure	V2: Average shrub height (ft.)

Species	Technique	Variable
Quail	Tape Measure/Range finder	V3: Distance to escape cover (ft)
	Tape/Graduated Rod	V4: Average diameter of escape cover
	Range finder/estimation	V5: Distance between escape cover patches (ft)

Specific Habitat Measurement Techniques:
Herbaceous measurements were taken at 20 or 25-foot intervals on the right side of the tape (the right is determined by standing at 0 feet and facing the line of travel/transect azimuth). A rectangular $0.5m^2$ micro-plot quadrant delineated into smaller rectangles was used to estimate percent cover of herbaceous vegetation. The frame was elevated 10cm above ground by attached legs. The near right hand corner was paced at the sampling interval (rectangle quadrats are placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval). Quadrat samples are considered independent samples for statistical purposes.

Herbaceous height was measured with a measuring rod placed within the quadrat frame. Three evenly spaced measurements were recorded and averaged for each sample. Only leaf material was measured (leaves provide the greatest amount of cover). Grass inflorescence was not included in height measurements.

Robel pole (Robel 1975) was used to document herbaceous vegetation visual obstruction readings (VOR). Measurements were taken at 20 or 25-foot intervals. Four observations were recorded and averaged per point to obtain a single visual obstruction reading or VOR (two measurements are taken four meters from the point on the transect line on opposite sides of the cover pole from a height of one meter; two measurements are taken from the point perpendicular to the transect line of travel).

Line Intercept (USFWS 1981) was used to measure basal area or canopy cover of herbaceous plants, shrubs, or trees. Collectors follow the transect tape in a straight line may record data at specific intervals. Plant canopies or basal areas are projected vertically to the tapeline and data is recorded to include hits, length of intercept, and species with allowance for overlapping plants. Height measurements were collected on the tallest part of a shrub that crossed directly above/below each sampling intercept.

Tree canopy cover measurements were recorded at five or ten foot intervals with a densitometer. Measurement interval was determined by visually estimating tree canopy closure prior to initiating the survey. If estimated canopy closure was less than 10% measurements were taken at five-foot intervals; if estimated greater than 10% canopy closure, a ten-foot interval was used. The sampling units were 100 foot segments of the transect.

Tree basal area information was collected at 100-foot intervals using a “factor 10” prism. Each 100-foot interval basal area observation (all tree “hits” at each 100-foot point) was considered an independent sample.

Snag data was collected with belt transects. Snags were detected and recorded within a tenth-acre belt transect paralleling the baseline transect (44 feet wide by 100 feet long i.e., 22 feet on each side of the baseline transect). The sampling unit was 100-foot segments. Diameter at breast height (dbh) (4.5 feet above ground) data was taken of all snags within the belt transect.

Data Analysis:

Habitat vegetation and structure data was tallied on Excel spreadsheets developed for CBFWA by Richare Stiehl. Data results were applied to individual HIS model habitat variables to obtain suitability indices (SI) for individual habitat variables and habitat suitability indices for each transect.

Habit variable SI values were recorded on HIS model spreadsheets by cover type. The suitability index results from multiple transects were averaged for each habitat variable. The mean results were referenced to suitability index graphs, resulting in an SI value (see Appendix B). Once all of the required habitat element variables were determined, the variables were put into a life requisite equations to obtain the HSI value. The resulting HSI score was multiplied by the total acreage for each applicable cover type, yielding the number of HUs for each model.

Results

Average HSI for each model as related to cover type, cover type acreage, and number of HUs are summarized in Table 4. The total habitat units for the property is 4,083.89. Habitat Suitability Index values ranged from zero to 0.9. HSI values were generally marginal. Habitat elements impacting the scores were usually related to a lack of shrub components or herbaceous cover.

The suitability index scores of the survey data at each transect was tallied and referenced to a suitability index graph. Tables of the index scores may be seen in Appendix B – Suitability indexes by Model and Transect.

Table 4. Baseline HSIs and HUs by Species and Cover Type.

Species	Acres	HSI	HU's
Mainstem Parcel			
California Quail			
Grassland	1757.8	0.58	1019.52
Juniper Forest	301.9	0.66	199.25
Juniper Steppe	194.2	0.90	174.78
Shrub Steppe	676.4	0.56	378.78
Black-capped chickadee			
Riparian Dec. Forest	69.7	0.38	26.49
Mallard			

Species	Acres	HSI	HU's
Meadow Grassland	440.7	0.62	273.23
Yellow Warbler			
Riparian Dec. Forest	69.7	0.40	27.88
Western Meadowlark			
Grassland	1757.8	0.53	931.63
Juniper Forest	301.9	0.69	208.31
Juniper Steppe	194.2	0.41	79.62
Shrub Steppe	676.4	0.46	311.14
		Total HU's	**3,630.65**

Middle Fork Parcel			
Mule Deer			
Conifer Forest	413.9	.01	4.14
Mink			
Riparian Shrub	.7	0	0
Black-capped chickadee			
Conifer Forest	413.9	.49	202.81
Mallard			
Meadow Grassland	340.3	.48	163.34
Yellow Warbler			
Riparian Shrub	.7	.52	.36
Western Meadowlark			
Grassland	359.1	.23	82.59
		Total HU's	**453.24**

Total HU's Forrest Conservation Area **4,083.89**

Discussion:

The models used in the HEP analysis indicate the overall habitat of the property is in fair condition. The HEP results clearly indicate the lack of shrub/tree cover within the riparian areas of the property. The lack of riparian shrub/tree cover along both the Middle Fork and Mainstem John Day River is a major limiting factor for several species used in the HEP. An increase of the shrub component would have a substantial benefit for yellow warbler, black-capped chickadee, mink, California quail, mallard, other fish and wildlife species, and additional HU's for the property.

Current and future management goals are to protect and where possible increase habitat units of the property. To increase and maintain the current HU's present will require both active and passive management for decades to come. Active restoration targeted at riparian areas for the expansion of shrubs and trees will provide the most benefit. Riparian fence exclosures, hardwood planting, and noxious weed control are examples of active restoration techniques that are currently being implemented to restore, enhance, and protect the riparian areas.

Black-capped chickadee habitat was found to be fair for the Middle Fork parcel and marginal for the mainstem. Transect data within the conifer and riparian cover types indicated a low number of snags present, which was the primary cause for the low SI average. Management to obtain older age class trees and snag protection will likely increase HU's and habitat for Black-capped chickadee and other wildlife dependant on snags for a food source and reproduction.

Western Meadowlark habitat was found to be marginal on the Middle Fork parcel and fair on the mainstem parcel. An increase of native grass habitat would provide the most benefit for the meadowlark. Invasive species present on the mainstem within the grassland habitat are western juniper, cheatgrass, and medusa head. These species have effectively suppressed and out competed natives in the majority of the grassland habitat. The low herbaceous cover that medusa head and cheat grass provides is of little value to the meadowlark that prefers grasses of moderate heights, also they are of little value for other wildlife.

Active juniper and non-native grass control is likely the best method for native bunch grass and shrub restoration. Upland restoration activities are essential to maintain the present fair habitat quality and HU's for meadowlark. California quail would also receive additional benefits from restoration due to a lack of shrub height and diameter.

Mule deer habitat was found to be poor on the Middle Fork parcel. Data from transects indicated low values for percent-preferred shrubs < l.5 meters in height and, percent canopy of all shrubs <1.5 meters in height. HU's would likely increase with an increase of preferred shrubs. Preferred shrubs are limited by competition with dense stands of lodgepole pine *(Pinus contorta)* and Douglas fir *(Pseudotsuga menziesii)*. Active thinning and prescribed control burn treatments combined with shrub planting are likely the only methods to obtain additional preferred shrubs.

Acknowledgements:
The Confederated Tribes of Warm Springs Reservation of Oregon would like to thank Paul Ashley and the WDFW field crew for their hard work, dedication and help in performing the fieldwork and report.

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Appendix A – HSI Graphs and life requisite equations for models

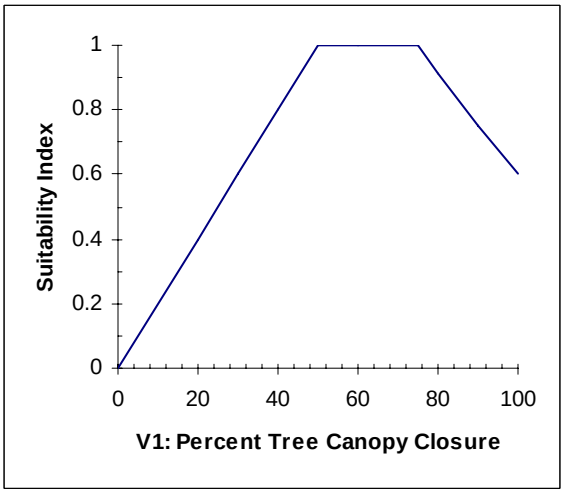
Black-capped Chickadee

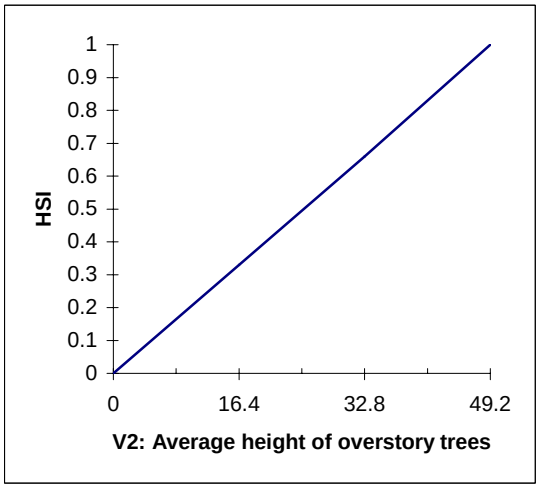
HSI determination for black-capped chickadee is based on two life requisite values, food and reproduction. The lower of the two values is equal to the HSI.

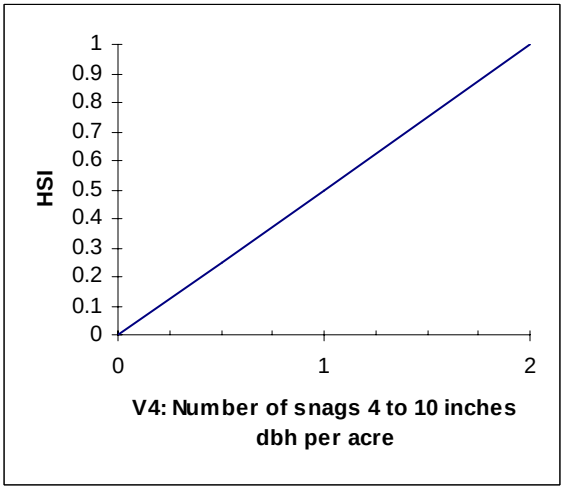
Food SI: $(V_1 \times V_2)^{\frac{1}{2}}$

Reproduction SI: V_4

Figure 4. SI Graphs for black-capped chickadee

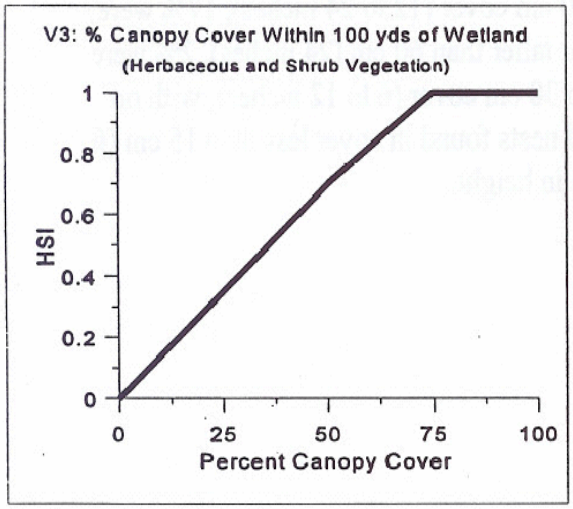


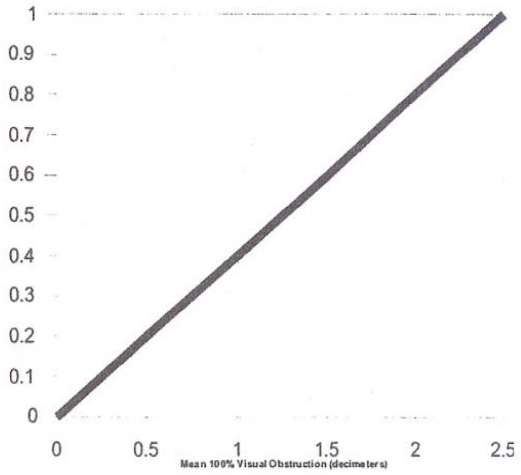




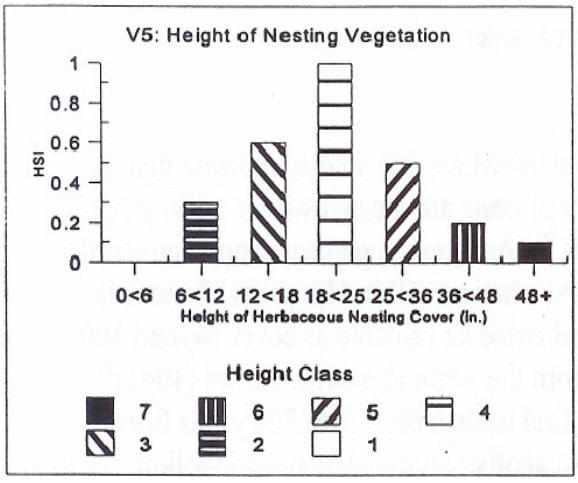
Mallard

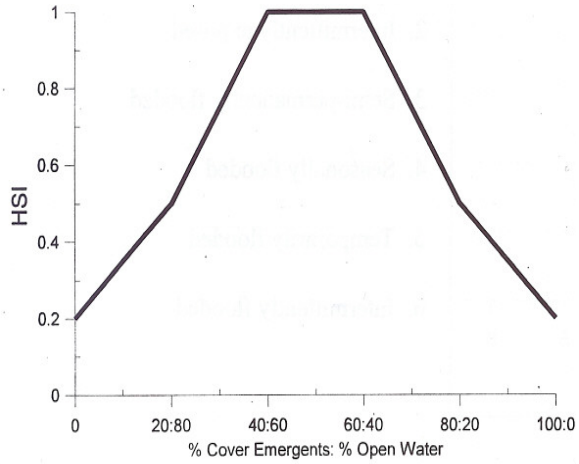
Figure 5. SI Graphs for Mallard





V7: VOR reproduction





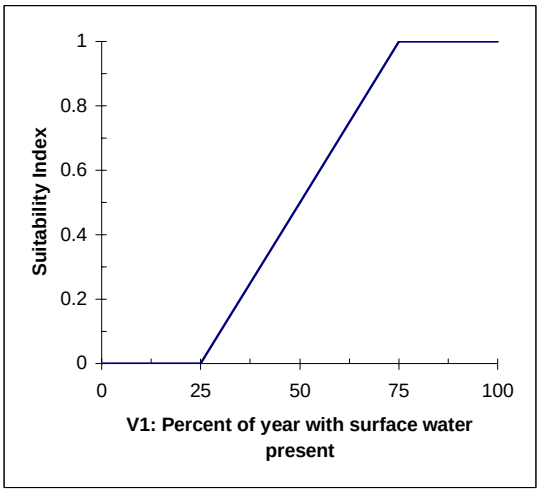
V6: Ratios of emergents

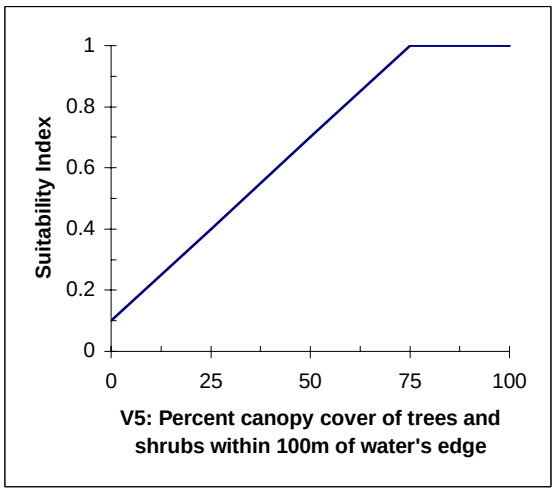
Mink

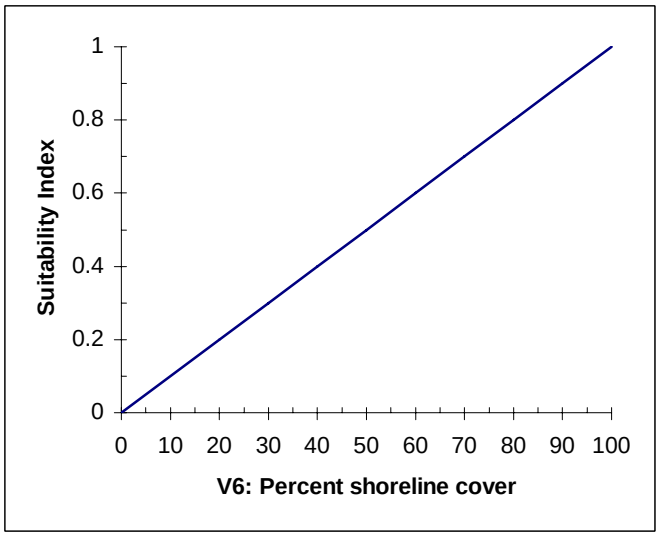
Figure 6. SI Graphs for Mink

Water SI: V1

Cover SI: $(V_5 \times V_6)^{\frac{1}{2}}$





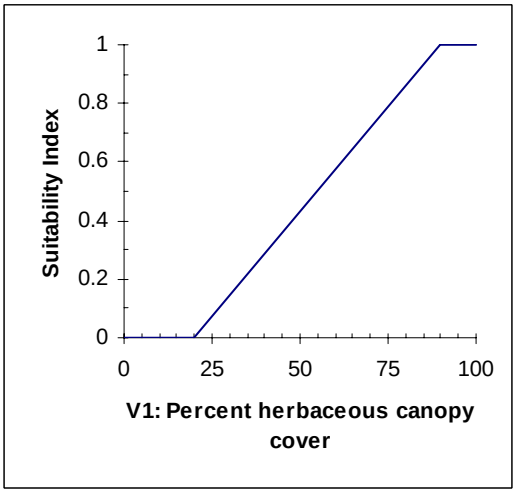


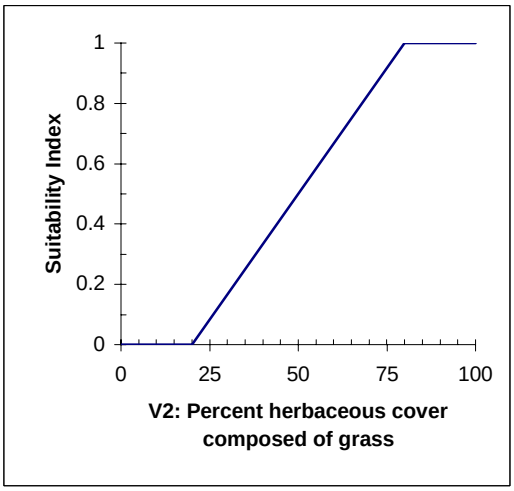
Western Meadowlark

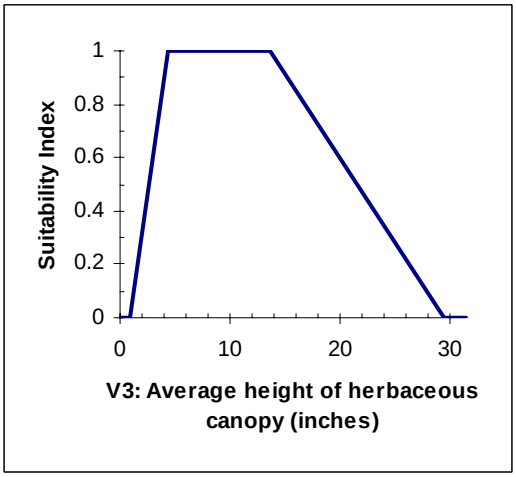
Western meadowlark has one life requisite equation for food and reproduction, containing five variables, for calculation of HSI.

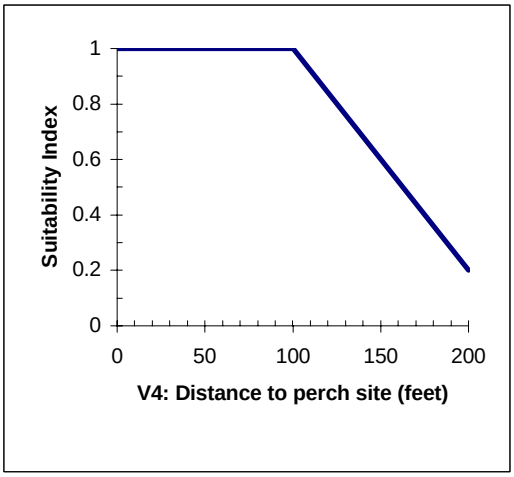
Figure 7. SI Graphs for Western Meadowlark

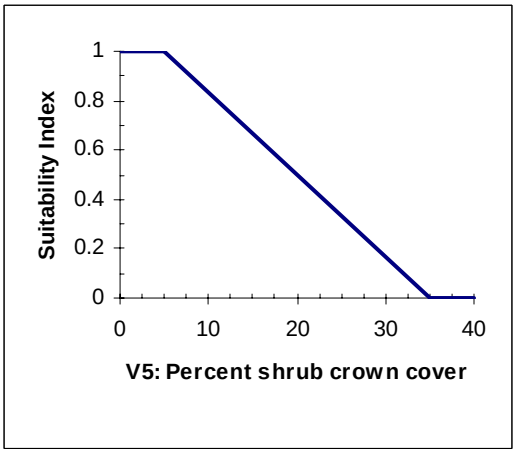
$$HSI = (V_1 \times V_2 \times V_3 \times V_4)^{\frac{1}{2}} \times V_5$$











Mule Deer

This HEP model was adapted from the Winter Habitat Suitability Model developed by Ashley and Berger (1999). This model was modified by Paul Ashley (WDFW), and reviewed by Terry Luther, Mark Berry, Brent Smith (CTWS), to meet habitat conditions found at the Pine Creek mitigation project site. Unlike the original model, this model considers annual forage and cover requirements of mule deer. Minimum suitability indices for food variables are 0.05 because it is assumed that mule deer forage habitat is available within 1.6 km (1 mi) of juniper stands (thermal and hiding cover) for at least a portion of the year. Water is assumed not to be a limiting factor. The relationship between habitat variables, life requisites, and the HSI is illustrated below.

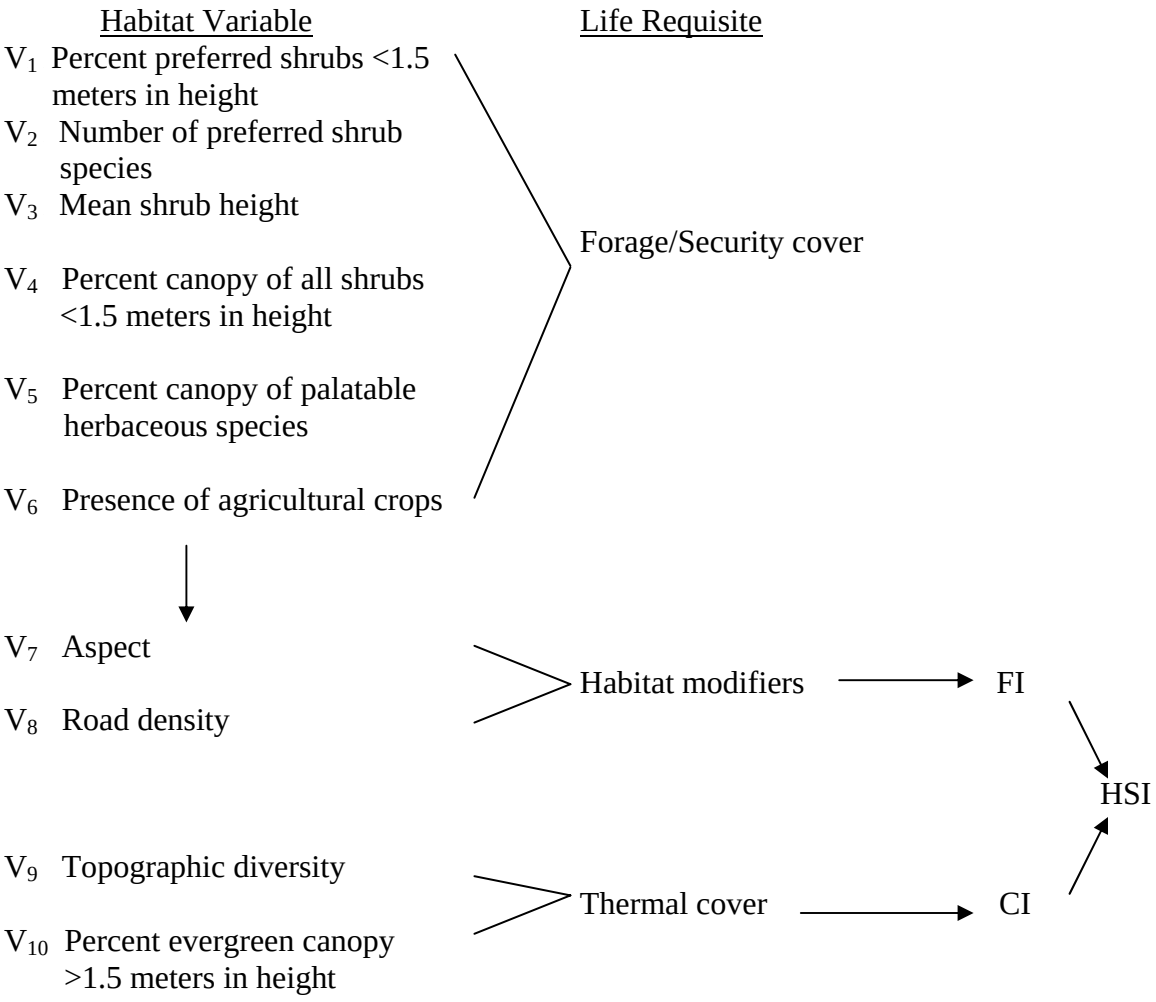
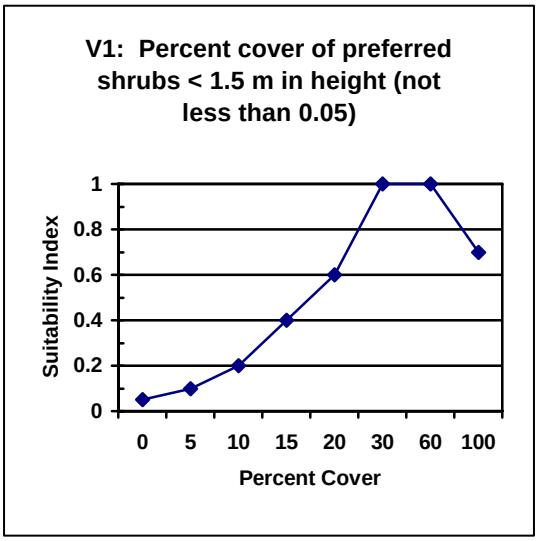
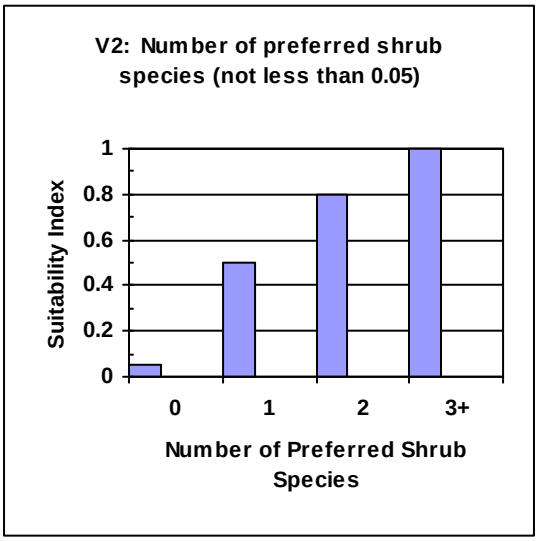
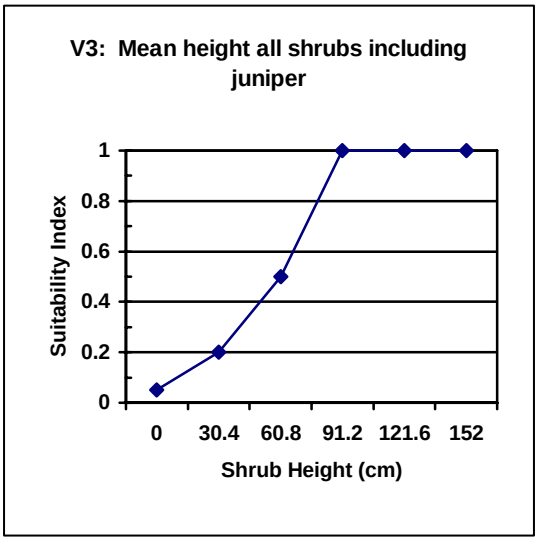
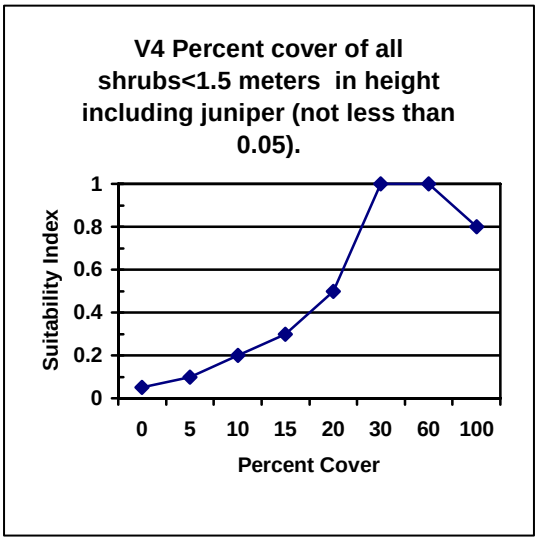


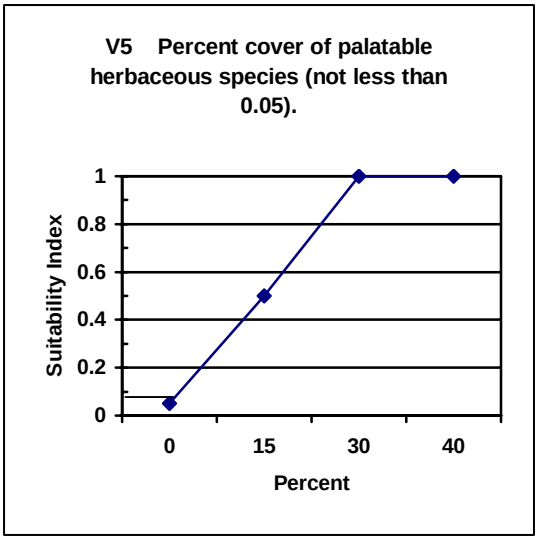
Figure 8. SI Graphs for mule deer







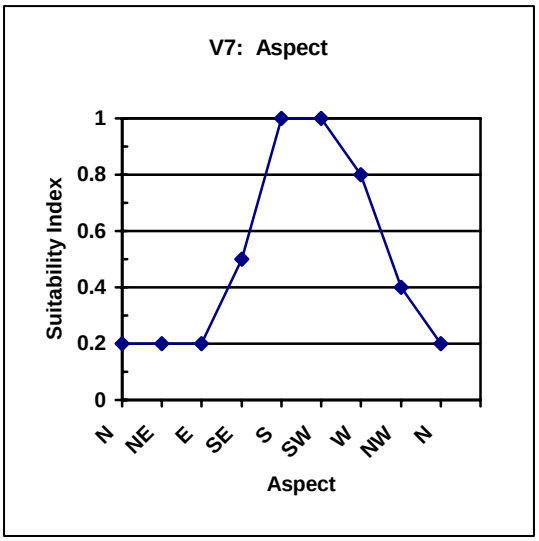


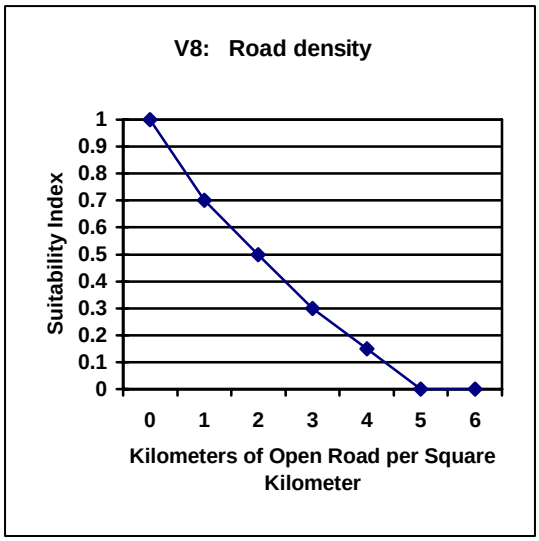


V_6: Presence of suitable agricultural crops within 1.6 kilometers (1 mile) of study area.

Yes: 0.1

No: 0.0





Food HSI = (((V1x V2 x V3 x V4 x V5) $^{1/5}$) + V6) x V7)^ $^{.625}$ x V8

Steps in calculating WFI with a hand calculator:

1. Obtain geometric mean of V1,V2, V3, V4, and V5
2. Add V6
3. Multiply sum obtained in step two by V7
4. Take the 1.66 root (^.6 on your computer)of product from step 3
5. Multiply result from step 4 by V8 to obtain HSI for food

V_9 Topographic diversity.

A: Level terrain less than 5 percent slope.
B: Level terrain broken by drainages.
C: Rolling terrain 5 to 25 percent slope.
D: Rolling terrain with rims, ridges, and/or drainages.
E: Mountainous terrain with slopes greater than 25 percent.

The cover index equation for shrub-steppe habitat emphasizes topographic diversity. The SI for woody evergreen vegetation greater than 1.5 meters (5 feet) in height is additive. The CI for shrub-steppe is described below. If the HSI is greater than 1.0, round down to 1.0.

Cover HSI = (V9 x .8) + V10

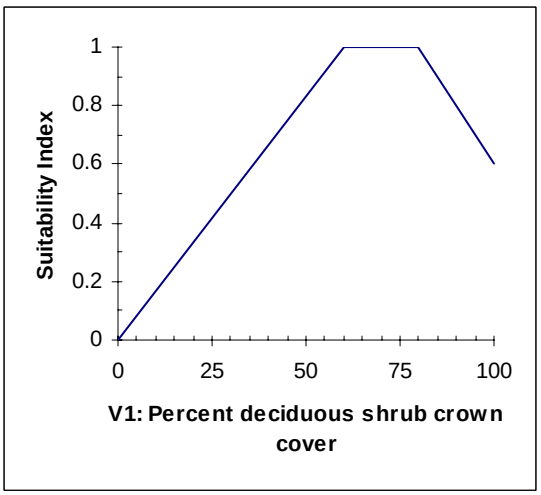
HSI determination: The calculation of a Habitat Suitability Index for mule deer considers the life requisite values obtained for food, habitat modifiers, and cover. The HSI is equal to whichever is lower; the food index (FI) or cover index (CI).

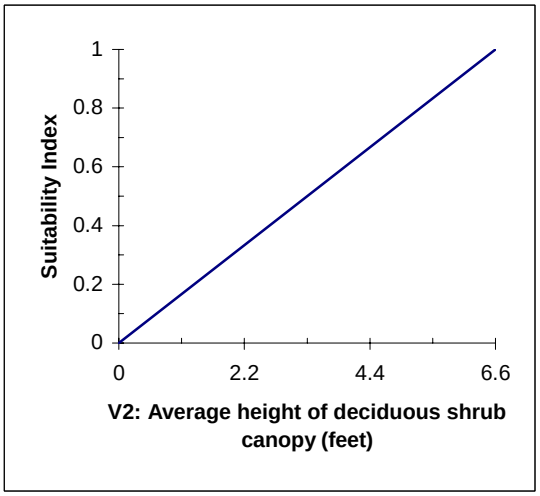
Yellow Warbler

The life requisite equation for yellow warbler is for reproduction, and its value determines the HSI.

Figure 9. SI Graphs for Yellow Warbler

$$HSI = (V_1 \times V_2 \times V_3)^{\frac{1}{2}}$$





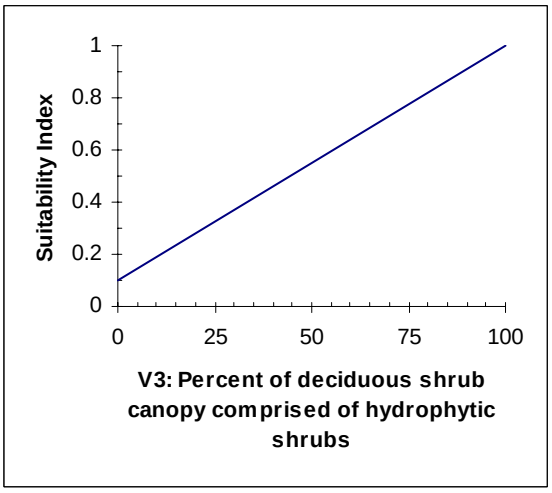
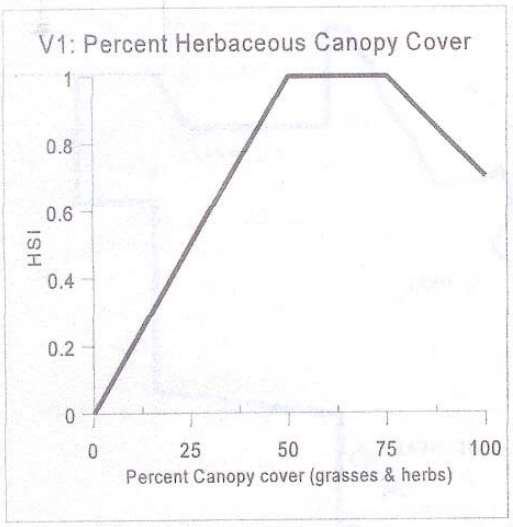


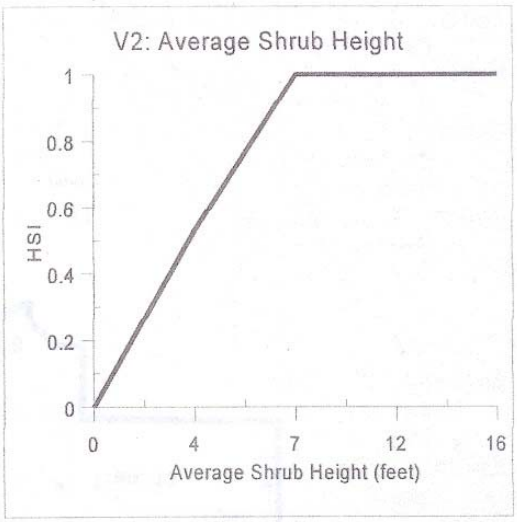
Figure 10. SI Graphs for California quail

Cover types: Riparian shrub, grassland, shrubgrass, shrubland, shrub-steppe, and agricultural

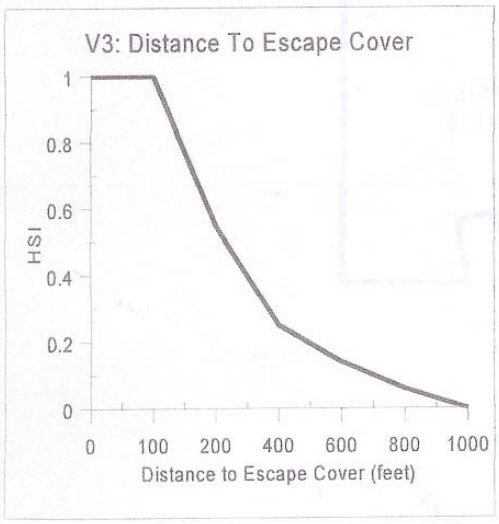
V1: Percent canopy cover of grasses and forbs



V2: Average Shrub Height (ft)

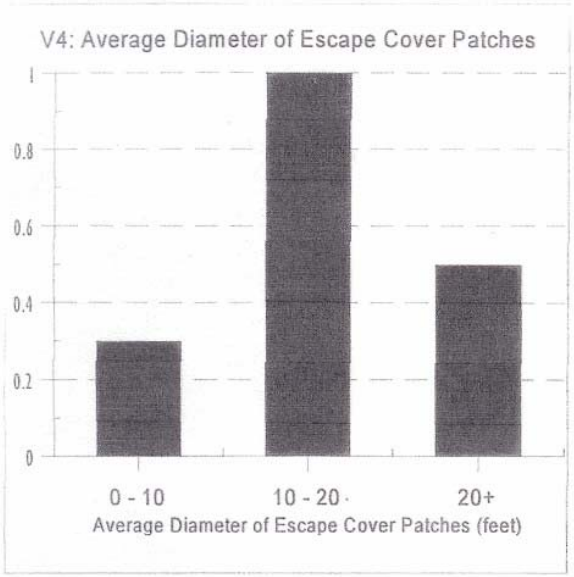


V3: Distance to escape cover (ft)

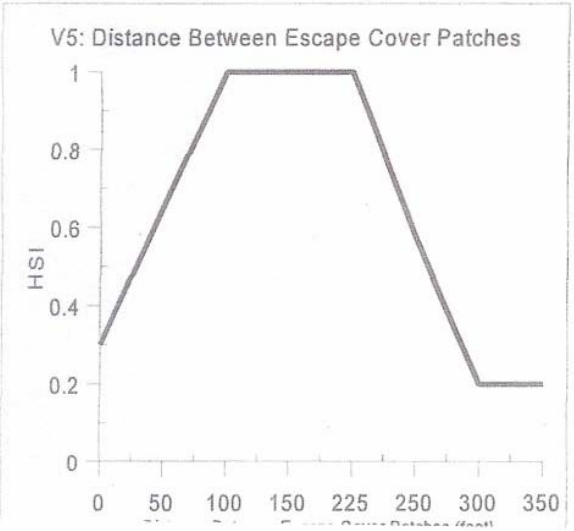


Escape cover is defined as dense shrubs, vine tangles, or dense grasses and forbs greater than 8 inches tall.

V4: Average Diameter of Escape Cover Patches (ft)



V5: Distance Between Escape Cover Patches (ft)



Quail HSI = $\frac{V1 + V2 + (V3 \times V4 \times V5)^{1/2}}{3}$

Appendix B – Suitability indexes by Model and Transect

Table 5. Black-capped chickadee transect data

Transect No.:	**15**	**10**	**7**	**6**	**292**	**26**	**338**	**21**	**15**
Cover Type:	Conifer forest				Riparian shrub tree				
	SI	SI	SI	SI	SI	SI	SI	SI	SI
V1: % Tree Canopy Closure	.7	.85	.95	.99	.80	1.00	1.00	.70	.70
V2: Ave. Ht. of Overstory Trees	1.00	1.00	1.00	1.00	.50	1.00	1.00	.99	1.00
V3: # Snags 4 to 10 inch DBH/acre	0.30	.50	.65	.50	.50	.50	.00	.40	.50
SI Food	.84	.92	.97	.99	.63	1.00	1.00	.83	.84
SI Reproduction	.30	.50	.65	.50	.50	.50	.00	.40	.50
Transect HSI	**.30**	**.50**	**.65**	**.50**	**.50**	**.50**	**.00**	**.40**	**.50**

Table 6. Mallard transect data

Transect No:	**11**	**4**	**336**	**29**
Cover Type	Meadow grassland			
	SI	SI	SI	SI
V1: % herb. cover	1.00	1.00	1.00	1.00
V2: Mean height of herb. Nesting cover	.28	.35	.6	.18
SI Reproduction	.53	.59	.77	.42
V6: Ration of Emergents (wetland cover SI)	1.00	1.00	1.00	1.00
V3: Distance to water	1.00	1.00	1.00	1.00
V5: Size of water body (ha)	1.00	1.00	1.00	1.00
SI Water interspersion	1.00	1.00	1.00	1.00
V7: VOR Reproduction SI	.40	.55	1.00	.39
Transect HIS	**.40**	**.55**	**.77**	**.39**

Table 7. Mink transect data

Transect No.:	**4**	**11**
Cover Type	Riparian Shrub	
	SI	SI
V1: % Of year with surface water present	1.00	1.00

Transect No.:	4	11
V5: % Canopy cover of trees and shrubs within 100m of wetland edge	0.00	0.00
V6: % Canopy cover within 1m of shoreline	.30	.19
Transect HSI	**0.00**	**0.00**

Table 8. Western Meadowlark transect data

Transect No.:	11	4	297	290	16
Cover Type(s):	Meadow grassland and grassland				
	SI	SI	SI	SI	SI
V1: % C.C. Herb. Plants	1.00	1.00	1.00	.50	1.00
V2: % Herb. C.C. Composed of Grass	1.00	1.00	1.00	1.00	.65
V3: Ave. Ht. of Herb. Canopy	1.00	1.00	.55	.01	.30
V4: Distance to Perch Sites	.01	.10	1.00	1.00	1.00
V5: % Shrub Canopy Cover	1.00	1.00	1.00	1.00	1.00
Transect HSI	**.10**	**.32**	**.74**	**.07**	**.44**

Table 9. Mule deer transect data.

Transect No.	15	10	7	6
Cover Type	Conifer forest			
	SI	SI	SI	SI
V 1: % C.C. pref. shrubs <1.5m in height	0.01	0.01	0.01	0.00
V 2: Number preferred shrub species	0.50	0.50	0.50	0.00
V 3: Mean height of shrubs	1.00	0.05	0.01	0.40
V 4: % C.C. all shrubs <1.5m in height	0.02	0.20	0.01	0.01
V 5: % C.C. palatable herbaceous vegetation	0.95	1.00	1.00	1.00
V 6: Pres. of winter wht./alfalfa (crops)	0.00	0.00	0.00	0.00
V 7: Solar radiation index	0.20	0.20	0.20	0.20
V 8: Road density	1.00	1.00	1.00	1.00
Winter Food HSI	0.01	0.01	0.01	0.00
V 9: Topographic diversity	0.70	0.70	0.70	0.70

Transect No.	15	10	7	6
V 10: % C.C. evergrn veg. > 1.5m in height	0.20	0.30	0.55	0.50
Winter Cover HSI	0.76	0.86	1.11	1.06
Transect HSI	**0.01**	**0.01**	**0.01**	**0.00**

Table 10. Yellow Warbler transect data.

Transect No.	26	338	21	15	292	12
Cover Type	Riparian shrub tree					
	SI	SI	SI	SI	SI	SI
V1: % Deciduous Shrub Crown Cover	0.85	0.30	0.45	0.20	0.45	.55
V2: Ave. Ht. of Deciduous Shrub Canopy	1.00	0.99	0.40	0.50	1.00	1.00
V3: % Deciduous Shrub Canopy Comprised of Hydrophytic Shrubs	0.60	0.35	0.10	0.65	0.55	.50
Transect HIS	**0.71**	**0.32**	**0.13**	**0.25**	**0.50**	**.52**

Table 11. California Quail transect data

Transect No.	297	290	16
Cover Type	Shrub steppe		
	SI	SI	SI
V 1: % Canopy Cover of grasses and herbs	1.00	0.75	1.00
V 2: Average shrub height (ft.)	0.10	0.10	0.10
V 3: Distance to escape cover (ft)	0.95	1.00	1.00
V 4: Average diameter of escape cover	0.30	0.30	0.30
V 5: Distance between escape cover patches (ft)	1.00	1.00	1.00
Transect HSI	**0.59**	**0.51**	**0.59**

Appendix C – Transect Data and Photos

Transect 004E Middle Fork photo point, June 25, 2003
Cover Type: Meadow Grassland
Transect Length: 600 feet
GPS Start point UTM 377121E, 4940493N

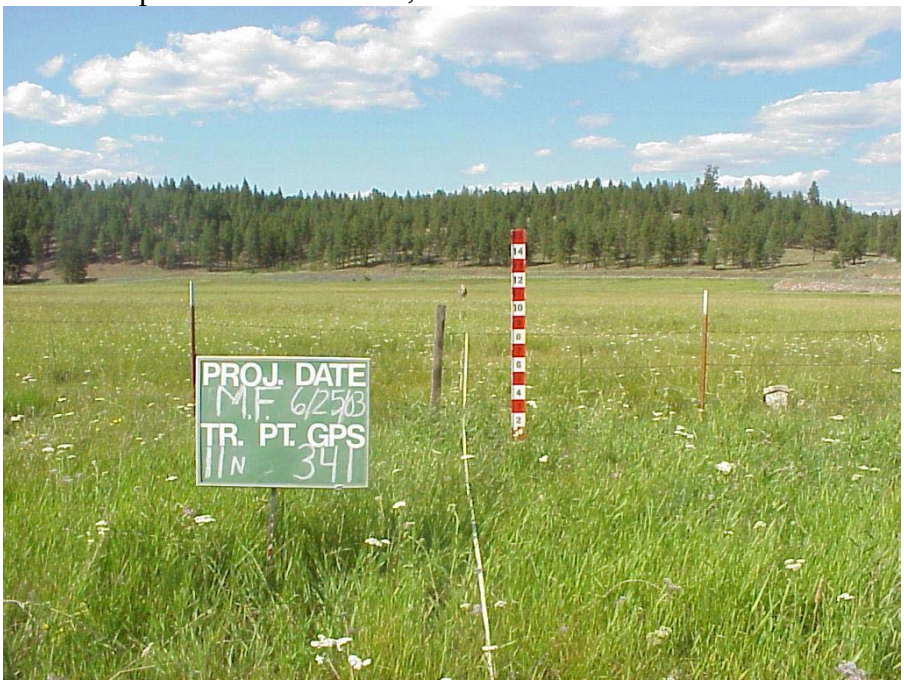
Transect 004S Middle Fork photo point June 25, 2003
Cover Type: Meadow Grassland
Transect Length: 2 laterals at 600 feet
GPS Start point UTM 377121E, 4940493N

Transect 006 Middle Fork photo point June 26, 2003
Cover Type: Conifer Forest
Transect Length: 1000 feet
GPS Start point UTM 377050E, 4940266N

Transect 007 Middle Fork photo point June 26, 2003
Cover Type: Conifer Forest
Transect Length: 1000 feet
GPS Start point UTM 377375E, 4939784N

Transect 10 Middle Fork photo point June 26, 2003
Cover Type: Conifer Forest
Transect Length: 1000 feet
GPS Start point UTM 378146E, 4939361N

Transect 011 N. Middle Fork photo point June 25, 2003
Cover Type: Meadow Grassland
Transect Length: 600 feet laterals
GPS Start point UTM 377228E, 4940377N



Transect 11 W. Middle Fork photo point June 25, 2003
Cover Type: Meadow Grassland
Transect Length: 600feet
GPS Start point UTM 377228E, 4940377N

Transect 012 Middle Fork photo point June 26, 2003
Cover Type: Riparian shrub
Transect Length: 900 feet
GPS Start point UTM 379560E, 4938808N

Transect 015 Middle Fork photo point June 26, 2003
Cover Type: Conifer Forest
Transect Length: 1000 feet
GPS Start point UTM 378642E, 4939132N

Transect 002 Mainstem photo point June 25, 2003
Cover Type: Juniper steppe
Transect Length: 600 feet
GPS Start point UTM 365059E, 4927633N

Transect 004 Mainstem photo point June 25, 2003
Cover Type: Grassland
Transect Length: 300 feet
GPS Start point UTM 364900E, 4927903N

Transect 005 Mainstem photo point June 25, 2003
Cover Type: Juniper Steppe
Transect Length: 600
GPS Start point UTM 365101, 4928499N

Transect 006 Mainstem photo point June 25, 2003
Cover Type: Grassland
Transect Length: 300 feet
GPS Start point UTM 365003E, 4928098N

Transect 007 Mainstem photo point June 25, 2003
Cover Type: Grassland
Transect Length: 300 feet
GPS Start point UTM 365703E, 4928400N

Transect 010 Mainstem photo point June 25, 2003
Cover Type: Juniper Steppe
Transect Length: 600 feet
GPS Start point UTM 366221E, 4927502N

Transect 011 Mainstem photo point June 25, 2003
Cover Type: Juniper forest
Transect Length: 600 feet
GPS Start point UTM 365542E, 4927250N

Transect 014 Mainstem photo point June 24, 2003
Cover Type: Juniper Steppe
Transect Length: 900 feet
GPS Start point UTM 366399E, 4926095N

Transect 015 Mainstem photo point June 24, 2003
Cover Type: Riparian shrub forest
Transect Length: 1000 feet
GPS Start point UTM 368166E, 4926430N

Transect 16 Mainstem photo point June 24, 2003
Cover Type: Shrub Steppe Transect Length: 600 feet
GPS Start point UTM 367100E, 4927098N

Transect 18 Mainstem photo point June 24, 2003
Cover Type: Juniper Steppe
Transect Length: 900 feet
GPS Start point UTM 366281E, 4927002N

Transect 21 Mainstem photo point June 24, 2003
Cover Type: Riparian shrub forest
Transect Length: 600
GPS Start point UTM 365797E, 4925337N

Transect 25 Mainstem photo point June 24, 2003
Cover Type: Juniper Steppe
Transect Length: 600 feet
GPS Start point UTM 365997E, 4925294N

Transect 26 Mainstem photo point June 24, 2003
Cover Type: Riparian shrub forest
Transect Length: 400 feet
GPS Start point UTM 366580E, 4923468N

Transect 29 Mainstem photo point June 25, 2003
Cover Type: Grassland
Transect Length: 600 feet
GPS Start point UTM 366472E, 4923609N

Transect 290 Mainstem photo point June 24, 2003
Cover Type: Shrub steppe
Transect Length: 600 feet
GPS Start point UTM 366640E, 4926150N

Transect 292 Mainstem photo point June 24, 2003
Cover Type: Riparian shrub forest
Transect Length: 600 feet
GPS Start point UTM 366696E, 4926753N

Transect 297 Mainstem photo point June 24, 2003
Cover Type: Shrub steppe
Transect Length: 600 feet
GPS Start point UTM 367071E, 4926945N

Transect 300 Mainstem photo point June 24, 2003
Cover Type: Grassland
Transect Length: 300 feet
GPS Start point UTM 367025E, 4927183N

Transect 306 Mainstem photo point June 24, 2003
Cover Type: Grassland
Transect Length: 600 feet
GPS Start point UTM 367250E, 4926127N

Transect 336 Mainstem photo point June 25, 2003
Cover Type: Grassland
Transect Length: 600 feet
GPS Start point UTM 365605E, 4924059N

Transect 338 Mainstem photo point June 25, 2003
Cover Type: Riparian shrub forest
Transect Length: 800 feet
GPS Start point UTM 365102E, 4924125N